# RADIOLOGICAL HAZARD

## OVERVIEW

*The Overview section defines the hazard and summarizes the hazard risk profile.*

### Definition

*This section defines the scope of the hazard category. The terminology and characterization established in this section should be consistent throughout all Howard County planning documents.*

An **Intentional Radiological (Attack) Hazard** occurs when a population is intentionally exposed to radiation through a non-nuclear mechanism (nuclear weapon hazards are profiled separately under "Nuclear Blast Hazard"). A radiological attack may take the form of a Radiological Exposure Device (RED) or a Radiological Dispersal Device (RDD) (also known as a dirty bomb).[1]

Radiological exposure devices may be concealed in public places, and people who pass close to the RED may be exposed to radiation. A RDD, or dirty bomb, is a mix of traditional explosives and radioactive powder or pellets. A dirty bomb is incapable of creating an atomic blast and should not be confused with an improvised nuclear device. A dirty bomb blast carries radioactive material into the surrounding area, but the main danger typically comes from the explosion, not the radiation.[2] REDs and RDDs are not capable of creating an atomic blast.

An **Unintentional Radiological Substance Release Hazard** occurs when radiation is accidentally discharged into the environment. Unintentional radiological substance releases may occur as the result of a nuclear power plant accident, a transportation accident, or a workplace incident.[3] An accident at a nuclear power plant could release a plume of dangerous radiation over an area. Radioactive materials in the plume zone can settle and contaminate buildings as well as people, food, water, and livestock who are outdoors. Radioactive material is also commonly transported by trucks and rail, but transportation accidents involving radioactive material rarely result in significant exposure to radiation. Workplace radiation incidents may occur in health care facilities, research institutions, and industrial operations if radiation sources are not stored correctly, safety controls malfunction, or safety procedures are not followed.

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[1] *More Information on Types of Radiation Emergencies,* CDC. Available at https://www.cdc.gov/nceh/radiation/emergencies/moretypes.htm (last accessed September 27, 2019).

[2] For additional information see *Radiological Attack: Dirty Bombs and Other Devices,* U.S. Dept. of Homeland Security (2004). Available at http://www.dhs.gov/xlibrary/assets/prep_radiological_fact_sheet.pdf (last accessed September 27, 2019).

[3] *More Information on Types of Radiation Emergencies,* CDC. Available at https://www.cdc.gov/nceh/radiation/emergencies/moretypes.htm (last accessed September 27, 2019).

# Risk Profile

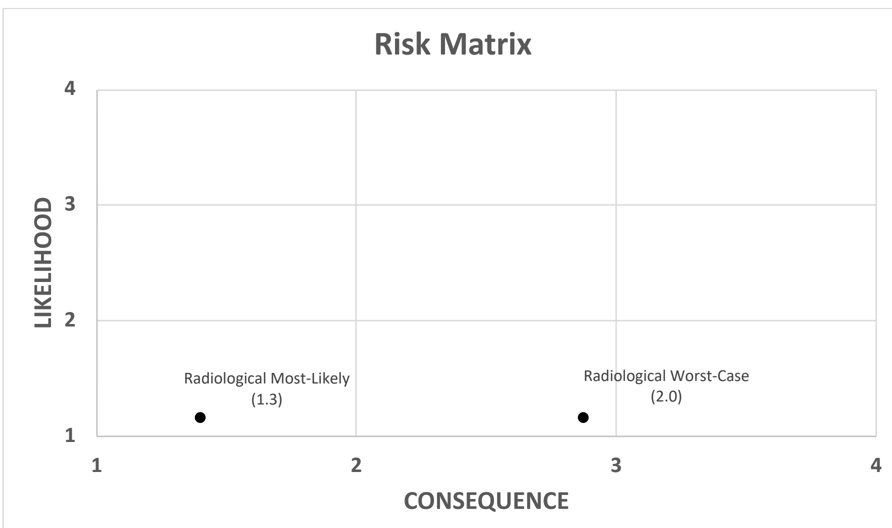
*The Risk Profile section presents the Risk Score for the hazard in a range from 1 (lowest risk) to 4 (highest risk). Risk Score is a function of Likelihood and Consequence.*

| Radiological Hazard Risk Profile | | | | | |
|---|---|---|---|---|---|
| LIKELIHOOD | **Risk Assessment Category** | **Likely Hazard Scenario** | **Worst-Case Hazard Scenario** | **Weight** |
| | **Likelihood** | 1.2<br>Unlikely-Infrequent | | 50% |
| CONSEQUENCE | **Impact** | 1.0<br>Limited | 2.7<br>Significant-Critical | 40% |
| | **Warning Time** | 4<br>Short | 4<br>Short | 5% |
| | **Duration** | 2<br>Moderate | 3<br>Long | 5% |
| **TOTAL RISK SCORE** | | **1.3** | **2.0** | |

**The Likelihood Score reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.*

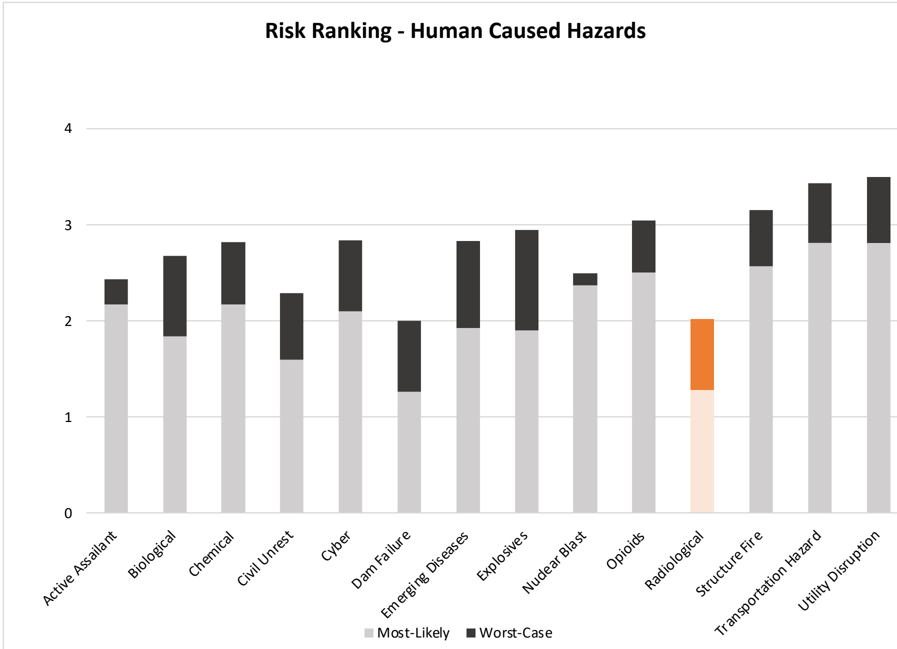
# Risk Matrix

*The Risk Matrix is a graphical illustration of hazard risk as a function of Likelihood and Consequence. Consequence includes the Impact, Duration, and Warning Time of the hazard.*



## Risk Ranking

*The Risk Ranking is a graphical illustration of hazard risk as it relates to other hazards.*




*Where no Worst-Case bar is visible, Worst-Case Risk is equivalent to Likely Risk.*

# HAZARD CHARACTERISTICS

*The Hazard Characteristics section provides a detailed characterization of the hazard and the local context as it relates to the hazard.*

## Description of the Hazard

Radiological attacks may take several forms. REDs are non-explosive devices containing radioactive material or emitting radiation. REDs are typically concealed in such a manner that people who come into close proximity to the RED receive exposure to radiation. REDs have extremely localized effects and may only affect people who are in physical contact or extremely close proximity to the device.

RDDs, or dirty bombs, use traditional explosives to disperse radioactive material. A dirty bomb blast carries radioactive material into the surrounding area. The area affected by an RDD explosion may range from less than a city block to several square miles. The spread of radioactive materials depends greatly on weather conditions, the type and amount of radioactive material, and the presence of barriers in the surrounding environment. However, most of the impact of a dirty bomb comes from the explosion rather than the radiation, so the area affected is highly dependent on the size of the explosive device. Like REDs, dirty bombs are incapable of creating an atomic blast and should not be confused with improvised nuclear devices. The explosive capacity of a dirty bomb is measured in pounds. This unit of measurement refers to the weight of TNT that would be required to release an equivalent level of explosive energy. The explosive capacity of a dirty bomb can range from one-10lbs for a small letter bomb, pipe bomb, or small package. A vest or container can contain a bomb with an explosive capacity of up to 20lbs. Cars, SUVs, and minivans can carry bombs with 500-4,000lbs of explosive capacity. A full-sized delivery truck bomb can reach 10,000lbs of explosive capacity.[4]

It is rare to have any advanced warning of a radiological attack. It is possible to have a radiological attack take place in a sparsely populated area, but typical radiological attack targets include densely populated locations such as office buildings, public gathering areas, special events, commercial areas, and transportation systems. The radiological exposure from a radiological attack depends greatly on the type of radioactive material dispersed. Exposure to radiation from a RED or dirty bomb may be minimal. Radiation dose is largely dependent on time, distance, and shielding.

The duration of a radiological attack is highly dependent on the mechanism of the attack. A RED may cause exposure for hours or even several days if the low dose of radiation goes unnoticed. A dirty bomb explosive hazard is typically instantaneous. Radioactive material released from the dirty bomb will decay rapidly during the first hours following the explosion. However, it can take several hours to bring the hazard under control and ensure that the area is safe. Secondary hazards such as fire, utility disruption, and transportation disruption may take a day or more to resolve.

Radiological substances may also be accidentally released into the environment in several different ways. An accident at a nuclear power plant can release a plume of dangerous radiation over an area. Radioactive materials in the plume can settle and contaminate buildings as well as people, food, water, and livestock who are outdoors. Radioactive materials are also commonly transported by trucks and rail, but transportation accidents involving radioactive material rarely result in significant exposure to radiation. Workplace radiation incidents may occur in health care facilities, research institutions, and industrial operations if radiation sources are not stored correctly, safety controls malfunction, or safety procedures are not followed.

The area affected by an unintentional radiological substance release depends greatly on the mechanism of release. A small release may affect a relatively localized site or stretch of road around the release zone. A larger release can easily affect several square miles, especially if radioactive material is spread by wind or water. A major nuclear reactor release can affect many square miles.

Health effects from radiation exposure depend on several factors, including:

- The type and amount of radioactive material released;
- The length of time that people were near the radioactive material, or the length of time the radioactive material was in or on the body;
- The proximity of individuals to the radioactive material or source of radiation; and,
- The parts of the body exposed to radiation.

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[4] For additional information see *IED Attack: Improvised Explosive Devices,* U.S. Dept. of Homeland Security. Available at http://www.dhs.gov/xlibrary/assets/prep_ied_fact_sheet.pdf (last accessed September 27, 2019).

The duration of an unintentional radiological substance release depends greatly on the mechanism of release and the type and amount of radioactive material released into the environment. Following a small release of radiological substances, it can take up to 12 hours to remove the hazard and decontaminate the environment. Following a larger release, radiological materials can be present in heavy doses for up to 12 hours while water and soil contamination create an ongoing radiological hazard for days or weeks. Radioactive materials have the potential to cause contamination for months or even years, but an accidental release of this size is extremely unlikely.

# *Local Context*

*The Local Context section describes community attributes that affect the likelihood of the hazard's occurrence or vulnerability to the hazard's consequences.*

A radiological attack may occur anywhere in Howard County. Likely targets for radiological attacks in Howard County include densely populated public areas such as schools, commercial facilities, event venues, and office buildings.

The location of Howard County may increase local vulnerability to radiological attacks and other terrorism-related attacks. Howard County is in close proximity to valuable terrorist targets including Washington, D.C., the City of Baltimore, the Port of Baltimore, and BWI Airport. Due to its proximity to the NCR, many Federal agencies, defense contractors, and high-profile targets maintain facilities within Howard County.

Unintentional radiological substance releases are most likely to occur in areas where radiological substances are frequently kept or transported. Radiological substances may be present in many of the medical centers and research facilities in and around Howard County. Radiological substances are transported through Howard County, making areas near railways and major roadways particularly vulnerable to unintentional radiological substance releases. There are no nuclear power plants in Howard County. Due to the distance of Howard County from Peach Bottom Atomic Power Station (PBAPS) (i.e., within 50-miles), it is likely that the County and residents may be impacted should there be a radiological emergency at PBAPS. Protective actions that may be implemented following an emergency at PBAPS are:

- Evacuating an area;
- Sheltering-in-place within a building or protective structure;
- Administering Potassium Iodide (KI) as a supplemental action;
- Relocation;
- Acquiring an alternate source of drinking water, and,
- Interdiction of food/milk.

# LIKELIHOOD ANALYSIS

*The Likelihood Analysis section characterizes the historical occurrence and future likelihood of the hazard in the planning area.*

## *Occurrence of the Hazard*

*The Occurrence of the Hazard section details the historical occurrence of the hazard in the planning area.*

Howard County is within 50 miles of Peach Bottom Atomic Power Station in York County, PA, 100 miles of Calvert Cliffs Nuclear Power Plant in Calvert County, MD, and 110 miles from Three Mile Island Nuclear Generation Station in Dauphin County, PA. While it is important to note all of the nearby nuclear power plants, it is essential to plan for and understand the unique consequences of being within a 50-mile radius of any nuclear power plant.

There have been zero radiological attacks in Howard County during the reviewed time period (2002-2022). There have, however, been two unintentional radiological substance release events in Howard County between 2002-2022. Both occurred in 2017. During the first incident, radiation was detected from improperly disposed of smoke detectors. During the second incident, radiation was detected from an improperly transported earth density gauge. There was an estimated total of two radiological hazard events during the reviewed time period of 1997-2022.

## *Future Likelihood for Howard County – Radiological Hazard*

*The Future Likelihood section anticipates the future occurrence rate of the hazard based on historical likelihood and future trends. This section also addresses factors that may cause the future likelihood to deviate from historical trends.*

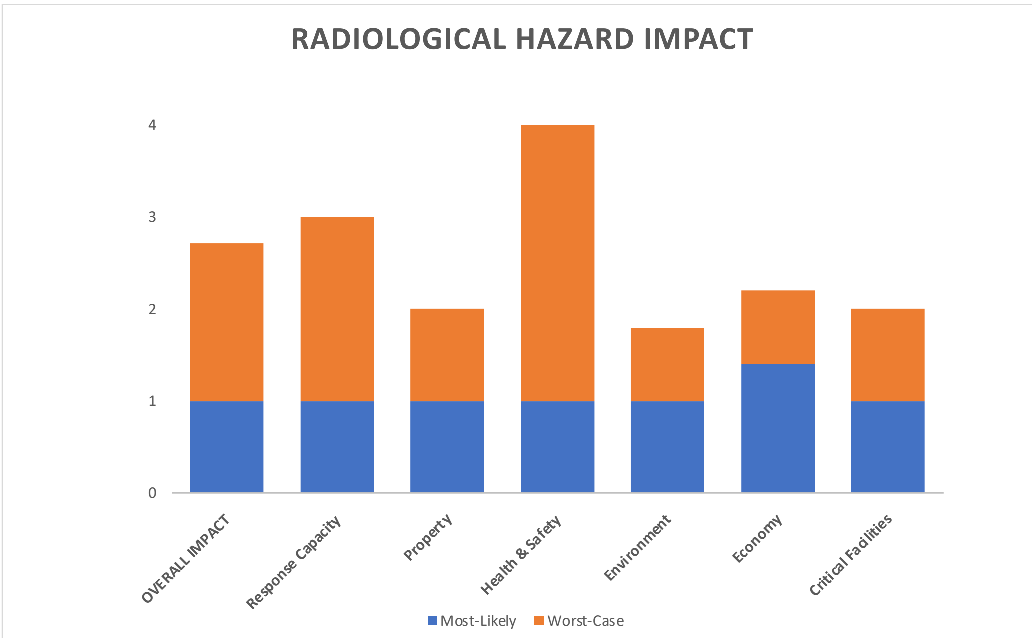
| **Future Likelihood of a Radiological Hazard in Howard County** | |
|---|---|
| **Historical Average (time period)** | 2 recorded events (2002-2022) |
| **Historical Annual Probability** | 1-10% chance of annual occurrence |
| **Future Likelihood Expected to Deviate from Historical Likelihood (Yes/No)** | No |
| **Future Annual Probability** | 1-10% chance of annual occurrence |
| **Future Likelihood Score** | 1.2 (Unlikely-Infrequent) |
| *Future Likelihood reflects the likelihood of any emergency-level hazard event and does not differentiate between Likely and Worst-Case scenarios.* | |

**Considerations:** The future annual probability of the hazard is 1-10% chance of annual occurrence, or one event 10-99 years. Howard County has never experienced a radiological attack, but several factors should be considered when weighing the future likelihood of an attack. Radiological attacks in the U.S. and abroad demonstrate the possibility of a successful attack inside Howard County. The increased threat of terrorism and the County's proximity to high value terrorist targets also contribute to a slight increase in the likelihood of a radiological attack in the future. Other considerations include the County's proximity to labs, medical facilities, power plants, and other facilities that have radiological materials.

# CONSEQUENCE ANALYSIS

*The Consequence Analysis section provides a detailed characterization of the anticipated consequences of likely and worst-case hazard events. This section characterizes impacts to property, health and safety, critical facilities, response capacity, the environment, and the economy. This section also characterizes the public perception of each hazard, the perceived impact to personal safety and standard of living, and public confidence in response capability.*

## *Consequence Analysis Overview*




*Where no Worst-Case bar is visible, Worst-Case impact is equivalent to Likely impact.*

| Radiological Hazard - Warning Time and Duration | | |
|---|---|---|
| | **Likely** | **Worst-Case** |
| **WARNING TIME** | *Short.* No warning time. | *Short.* No warning time prior to an attack unless a “group” provides a warning/threat. |
| **DURATION** | *Moderate.* Hazard onset is nearly instantaneous. It may take six to 12 hours to declare the hazard location safe. | *Long.* Hazard onset is nearly instantaneous. It may take up to 72 hours for emergency response, longer for law enforcement investigation. |

# Consequence Analysis: Likely Hazard Scenario

*The Consequence Analysis table details the anticipated consequences of the most likely hazard scenario.*

| Radiological Hazard - Consequence Analysis<br>Likely | | |
|---|---|---|
| **CATEGORY** | **RANKING** | **DESCRIPTION** |
| **PROPERTY DAMAGE** | *Limited* | ▪ 0% damage to critical and non-critical infrastructure. |
| **HEALTH AND SAFETY** | *Limited* | ▪ Zero deaths likely.<br>▪ Zero injuries likely. |
| **CRITICAL FACILITIES** | *Limited* | ▪ *Utilities* – Shutdown unlikely. No effect on utilities.<br>▪ *Information/Communications* – Shutdown unlikely. No major impact on information or communications infrastructure.<br>▪ *Transportation* – Delays unlikely. |
| **RESPONSE CAPACITY** | *Limited* | ▪ *Police* – Local resources adequate. Sheriff's office may be needed to support operations.<br>▪ *Fire and Rescue* – Some need for specialized resource response. Sustained mutual aid or other assistance not required<br>▪ *Health* – Local resources adequate. HD operations will not be affected.<br>▪ *Hospitals* – Local resources adequate. No major impact to the hospital system. Hospital decontamination will likely be unnecessary if decontamination takes place at the site.<br>▪ *Emergency Management* – Moderate need for state or federal assistance. Some planning support may be necessary for hazardous materials cleanup, but not likely to be a prolonged effort. |
| **ENVIRONMENTAL IMPACT** | *Limited* | ▪ Limited environmental impact. The radiation will likely disburse rapidly from the environment, and consequences to air, water, and land should be limited. |
| **ECONOMIC IMPACT** | *Limited-Significant* | ▪ Some minimal loss of economic output due to potential for public panic regarding radiation exposure.<br>▪ Other costs include cleanup and healthcare for those affected.<br>▪ Zero jobs lost. |
| **TOTAL IMPACT** | ***Limited*** | ▪ **Total Impact Score: 1.3 on a scale of 1 (Limited) to 4 (Catastrophic).** |

| *Limited* | *Significant* | *Critical* | *Catastrophic* |
|---|---|---|---|

# Consequence Analysis: Worst-Case Hazard Scenario

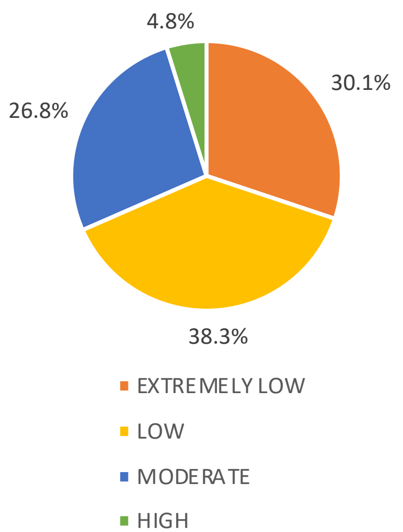
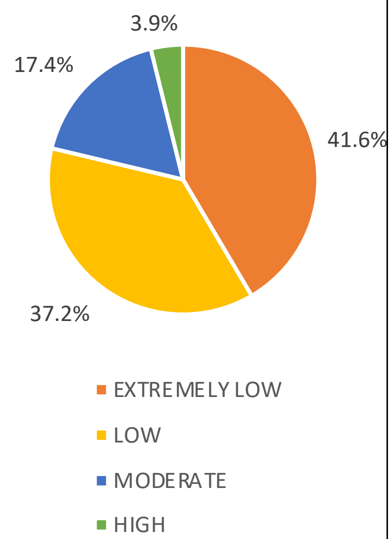
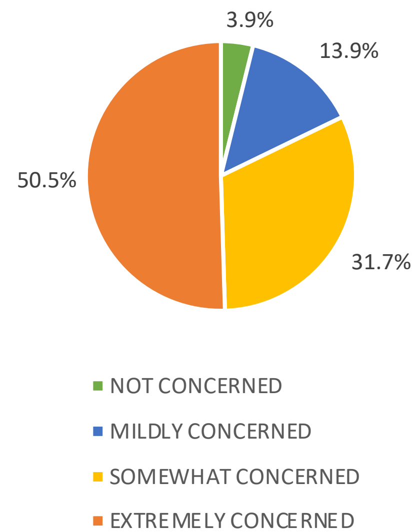
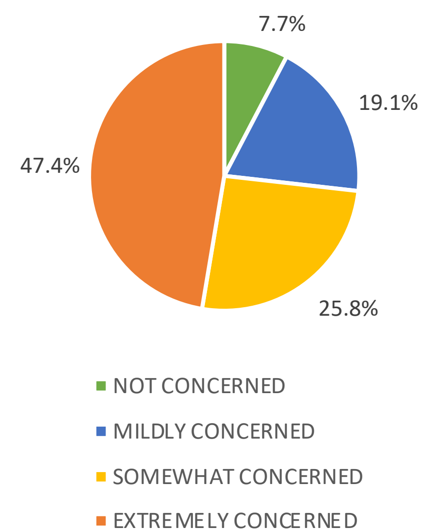
*The Consequence Analysis: Worst-Case table details the anticipated consequences of the worst-case hazard scenario that could reasonably occur within the jurisdiction.*

| Radiological Hazard - Consequence Analysis<br>Worst-Case | | |
|---|---|---|
| **CATEGORY** | **RANKING** | **DESCRIPTION** |
| **PROPERTY DAMAGE** | *Significant* | ▪ The explosion from a large radiological dispersion device could be sufficient to cause building collapse. The attack may cause superficial damage to property and structures within several blocks of the attack site. Most of the property damage from a Radiological Attack hazard will be the result of the explosive rather than the radiation. |
| **HEALTH AND SAFETY** | *Catastrophic* | ▪ 50-100 deaths likely and 100-300 injuries likely, dependent on the population density at the site of the attack. Deaths and injuries are most likely due to trauma from the explosive blast rather than the radiation. |
| **CRITICAL FACILITIES** | *Significant* | ▪ *Utilities* – Shutdown unlikely. No effect on utilities.<br>▪ *Information/Communications* – Shutdown unlikely. Likely stress on information or communications infrastructure due to increased public communication.<br>▪ *Transportation* – Delays for three to five days. Major transportation delays will be caused by people exiting the surrounding area. Major closures will occur in the immediate aftermath of the attack, and localized transportation routes will be closed for days. |
| **RESPONSE CAPACITY** | *Critical* | ▪ *Police* – Mutual aid needed. Terrorism response automatically triggers Federal law enforcement involvement. Sheriff's office may be needed to support operations.<br>▪ *Fire and Rescue* – Significant and long-lasting need for state or federal assistance. There will likely be long-lasting impact to hazardous materials response capabilities. Regional EMS resources will be overwhelmed.<br>▪ *Health* – Moderate need for state or federal assistance. Regular HD operations will not be affected. Health emergency preparedness, communicable diseases, and environmental health functions will be altered.<br>▪ *Hospitals* – Mutual aid needed. Howard County General Hospital is not a trauma center, resulting in the need to divert all explosive blast injuries to other hospitals. A large influx of psychological casualties (worried well) may strain the hospital.<br>▪ *Emergency Management* – Moderate need for state/federal assistance. Significant planning support may be necessary for hazardous materials and terrorism investigation. There is no significant impact to emergency management COOP. |
| **ENVIRONMENTAL IMPACT** | *Limited-Significant* | ▪ Limited environmental impact. The radiation will likely disburse rapidly from the environment, and consequences to air, water, and land should be limited. Lasting environmental impact will be minimal, but public perceptions of environmental danger may significantly outlast any actual environmental impact. |
| **ECONOMIC IMPACT** | *Significant-Critical* | ▪ Some loss of economic output in the area affected. Other costs include cleanup and healthcare for those affected.<br>▪ Temporary job loss is likely in the impacted area. Significant impact on Howard County image. |
| **TOTAL IMPACT** | ***Significant - Critical*** | ▪ **Total Impact Score: 2.7 on a scale of 1 (Limited) to 4 (Catastrophic).** |

| *Limited* | *Significant* | *Critical* | *Catastrophic* |
|---|---|---|---|

## *Consequence Analysis: Public Perception*

*The Consequence Analysis: Public Perception table characterizes public perceptions of each hazard. Details include public confidence in personal ability to respond to each hazard, public confidence in Howard County's ability to respond to each hazard, and each hazard's perceived impact to personal safety and standard of living.*

| Radiological Hazard - Public Perception | | | |
|---|---|---|---|
| *Perceived confidence in Howard County's ability to respond and recover from this hazard* | *Perceived confidence in their personal ability to protect self and family from this hazard* | *Concern over the impact to personal health and safety if this hazard were to occur locally* | *Concern over the impact to personal standard of living or quality of life if this hazard were to occur locally* |
|  |  |  |  |